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NOTES ON THE MYRMECOPHILOUS BEETLES OF THE GENUS *XENODUSA*, WITH A DESCRIPTION OF THE LARVA OF *X. CAVA* LECONTE.¹

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Our knowledge of the singular beetles of the North American genus *Xenodusa*, in contrast with that of the European species of the closely allied genera *Lomechusa* and *Atemeles*, increases very slowly. This is unquestionably due to the much greater scarcity and more local distribution of the species of *Xenodusa*. In a paper published in 1907² I reviewed the scattered observations of other authors on these beetles and added a few of my own. After four years I am able to make a further slight contribution in the form of a description of the larva of *X. cava*, together with a few notes on the hosts of this and of some of the western species.

Wasmann has shown that *Lomechusa strumosa* is homœcious, or has only one host, the typical form of *Formica sanguinea*, with which it lives throughout the year, whereas the species of *Atemeles* and *Xenodusa* are heterœcious, since they breed during the summer in the nests of *Formica* but hibernate with ants of a different genus. The winter host in the case of *Atemeles* is *Myrmica rubra* or some one of the closely allied species (*scabrinodis*, *levinodis*, *rugulosa*, etc.) which were formerly regarded as mere subspecies. *Xenodusa*, however, winters in the nests of *Camponotus* species. The definitive and almost certainly the primitive host is, therefore, in both genera, *Formica*, while the winter host is a later or secondary acquisition. The genus *Lomechusa* probably represents a very primitive condition so far as its relation to a single host is concerned, though in other respects it certainly represents a more advanced stage of parasitism or of dependence on its host.

¹ Contributions from the Entomological Laboratory of the Bussey Institution of Harvard University, No. 41.

² The Polymorphism of Ants, with an Account of Some Singular Abnormalities Due to Parasitism. Bull. Amer. Mus. Nat. Hist., XXIII, 1907, pp. 1-93, pls. I-IV.

I have been unable as yet to find *X. cava*, during its breeding season, with any ant except *Formica schaufussi* var. *incerta*, but McCook³ claims to have taken it with *F. exsectoides* in Pennsylvania, and Muckermann⁴ believes that it occurs with *F. sanguinea* subsp. *rubicunda* in Wisconsin, because in the nests of this ant he found pseudogynes comparable to those described by Wasmann from nests of the typical *F. sanguinea* infested with *Lomechusa strumosa*.

Concerning six larvæ of *X. cava* which I found July 1, 1905, in a nest of *F. incerta* at Colebrook, Conn., I published the following note in my former paper: "They were clinging to the lower surface of the stone covering the nest. I transferred them to an artificial nest together with as many of the ants as I could capture. The larvæ associated themselves with the brood which the ants had collected in the cavities of the damp sponge in the dark chamber of the nest. They walked about but little and very clumsily as their legs seemed to be incapable of much movement at the strongly flexed articulation between the femora and tibiæ. They were frequently seen in the act of begging the ants and one another for food. At such times they raised their fore feet and stroked the head of the ant or fellow larva. Although the ants usually responded very willingly to this solicitation, the liquid food thus received seemed to be insufficient, for one morning I saw one of the *Xenodusa* larvæ seize and devour an ant larva about 3 mm. in length. On July 7 two of the *Xenodusa* larvæ had disappeared (eaten by the ants?) and the remaining four had become somewhat inactive after having grown appreciably during their week's confinement in the artificial nest. Fearing that the ants might devour the remaining parasites, and concluding from their size that they must be nearly ready to pupate, I removed them from the nest and embedded them in some earth. This proved to be disastrous as I had not taken the precaution to sterilize the earth which must have contained some predaceous insect. At any rate, I could find no traces of the larvæ when I carefully examined the earth several days later."

Diligent search for *Xenodusa* larvæ since these remarks were written, was fruitless till June 13, 1910, when I found a single speci-

³ Mound-making Ants of the Alleghenies, their Architecture and Habits. Trans. Amer. Ent. Soc., VI, 1877, pp. 253-296, pls. I-VI.

⁴ *Formica sanguinea* subsp. *rubicunda* Em. and *Xenodusa cava* Lec. Ent. News, Dec., 1904, pp. 339-341, pl. XX.

men clinging to the lower surface of a stone covering a *F. incerta* nest at Forest Hills, Mass. This specimen, which is represented in the accompanying figure, measures nearly 6 mm. in length and is probably about one-half or two-thirds grown. Its milk-white body is broad and flat in the middle but narrowed at the anterior and posterior ends which are turned up. Eyes are absent. The antennæ and legs are well-developed, the last abdominal segment slender and

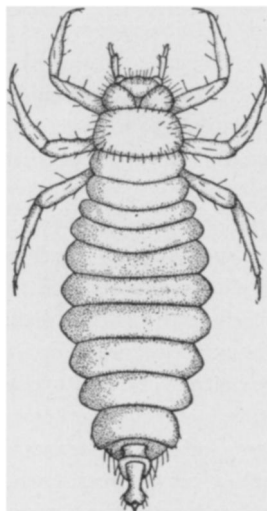


FIG. 1. Larva of *Xenodusa cava* Lec.

of a peculiar shape. The vertex of the head is deeply and triangularly impressed in the middle. There are a few delicate, scattered hairs on the legs, antennæ, head, pronotum, venter and terminal abdominal segments; on the remaining portions of the body the hairs are very short, sparse and inconspicuous.

Comparison of this larva with that of *Lomechusa strumosa* which has been described by Wasmann⁵ and which I have taken in numbers in *F. sanguinea* nests in the Alps, shows many striking differences. The *Lomechusa* larva is more slender and cylindrical, its antennæ are reduced to mere papillæ, its legs are very short and feeble, its terminal abdominal segments are conical and the whole body is in-

⁵ Vergleichende Studien über Ameisen- und Termitengäste. Tijdschr. v. Ent., XXXIII, 1890, pp. 27-96, 1 pl.

vested with rather dense, short hairs. The impression of the vertex is shallow.⁶

I have not seen the larva of *Atemeles*, but that of *A. paradoxus* from nests of *F. rufibarbis* was long ago described and figured by Wasmann.⁷ His figures show that this larva, though it has somewhat longer legs and antennæ than the *Lomechusa* larva, nevertheless resembles it much more closely than it does the larva of *Xenodusa*. Wasmann states that the *Lomechusa* larvæ are "still more passive in their behavior and almost never use their legs, and therefore play the rôle of ant-larvæ more perfectly than do the larvæ of *Atemeles*." That the *Atemeles* larvæ walk about rather easily is evident also from some remarks in a paper by Schmitz.⁸ This author and more recently Wasmann⁹ have shown that *Atemeles* larvæ when ready to pupate, do not have to be buried by the ants, like the very passive *Lomechusa* larvæ, but are able to crawl into the soil and pupate of their own free will. There can be little doubt that this is also true of the *Xenodusa* larva, for its very high structural organization, together with the few notes on its behavior quoted above, show that it must lead a much more independent life in the colonies of its host than do the larvæ of either of the European genera. This independence and the much less perfect resemblance to the ant-larva may, perhaps, explain why the species is so scarce and sporadic. In other words, *F. incerta*, though a very cowardly ant and the regular host of such synœketes as *Microdon tristis*, *Coscinoptera dominicana* and *Cremastocheilus castaneæ*, and such social parasites as *Polyergus lucidus*, *Formica consocians*, *F. sanguinea* subsp. *subintegra* and *rubicunda*, is probably not easily deceived into rearing and cherishing the parasitic beetle larvæ which so ruthlessly devour its brood. That this ant may be occasionally deceived is, however, proved by the abundant occurrence of pseudogynes in certain colonies, as I have shown in my paper on the polymorphism of ants.

⁶ I have given a figure of this peculiar larva in my book: "Ants, their Structure, Development and Behavior," 1910, p. 401.

⁷ Beiträge zur Lebensweise der Gattungen *Atemeles* und *Lomechusa*. Tijdschr. v. Ent., XXXI, 1888, pp. 245-328.

⁸ Die Ursachen der Doppelwirtigkeit bei *Atemeles*. Deutsch. Ent. Nat. Biblioth., I, Nos. 1 and 2, 1910, pp. 6-7, 13, 14.

⁹ Zur Doppelwirtigkeit der *Atemeles*. Deutsch. Ent. Nat. Biblioth., I, Nos. 7 and 8, 1910, pp. 55, 56; 62-64.

According to Wasmann¹⁰ "the species of *Xenodusa*, in the shape of the labium, are intermediate between *Atemeles* and *Lomechusa*. In other respects also the nearctic genus *Xenodusa* connects, so to speak, the two old world genera, in so far namely, as some of the species (especially *X. caseyi*) resemble *Atemeles* in thoracic structure, while others (*X. sharpi*) are more like *Lomechusa*." He adds, however, that notwithstanding these intermediate characters, "we are unable to regard *Xenodusa* as a connecting link between *Atemeles* and *Lomechusa*, since the much elongated shape of the antennæ and legs indicates a peculiar direction of development, which is not observable in the two old world genera and is probably to be interpreted as an adaptation to the relatively very large hosts of *Xenodusa* (*Camponotus*, *Formica*).". The larval characters above described certainly seem to confirm Wasmann's view of the peculiar and independent developmental trend of the genus *Xenodusa*, and the long legs and antennæ of the adult beetle are, indeed, in all probability, an adaptation to its hosts, since these organs are very long in the *Camponoti* with which it passes the winter and in *F. incerta*, which, like the other forms of the *pallide-fulva* group, has much more slender legs and antennæ than any of our other *Formica*. The great length of the appendages in the larva must be directly correlated with their unusual length in the imaginal beetles.

The recorded winter hosts of *X. cava* are *C. herculeanus* subsp. *pennsylvanicus* and *C. ligniperda* var. *noveboracensis*. To these must be added *C. pennsylvanicus* var. *ferrugineus*, as Dr. A. Fenyès has shown me one specimen of the beetle taken in a nest of this ant at Bloomington, Indiana. Still another host has been recently discovered by Messrs. W. Reiff and E. H. Strickland, April 19, 1911. These young men found a couple of the beetles in two colonies of *C. castaneus* subsp. *americanus* at Norwood, Mass. This being a ground-inhabiting *Camponotus*, would seem to be a more natural winter host than the various wood-inhabiting forms of *C. herculeanus* with which it has always been taken heretofore.

On May 6, 1911, I took a specimen of *X. cava* resting on a stump near the top of Great Blue Hills, near Boston, Mass. As there was no *Camponotus* colony in the stump, nor within several yards of

¹⁰ Zur Biologie und Morphologie der *Lomechusa*-Gruppe. Zool. Anzeig., 1897, pp. 463-471.

the spot, the beetle must have been in the act of migrating to a colony of its summer host, *F. incerta*, which is very abundant in the same region. The beginning of May may therefore be set down as the time of the spring migration. The migration from the *incerta* back to the *Camponotus* nests takes place, in all probability, during the last week of July or first week of August, since I have a record of finding a very fresh and light-colored specimen of the beetle in a nest of *C. noveboracensis* at Colebrook, Conn., July 28, 1910. These dates indicate, therefore, that the breeding period of *X. cava*, or its life with the definitive, or summer host, covers a period of only three months, and that it spends the remaining nine months of the year with its intermediate host.

An examination of Dr. A. Fenyès's collection of Aleocharinae during the past winter, enables me to add the following notes on the hosts of two of the western species of *Xenodusa*:

1. The type specimen of *X. angusta* in this collection was taken from a colony of *Camponotus fallax* subsp. *discolor* var. *clarithorax* living in a gall of *Andricus pomiformis* on live oak (*Quercus agrifolia*) in the Gran Arroyo Seco at Pasadena, California. The *Camponotus* is therefore the winter host of this small *Xenodusa*; its summer host is probably *F. pilicornis*, the only *Formica* I could find in the portion of the Arroyo in which the beetle was captured.

2. Dr. Fenyès showed me several specimens of *X. montana* which he had taken from nests of *C. levigatus* at McCloud, Castle Crag and Sissons, Cal., and a specimen of the same beetle found in a colony of *C. herculeanus* var. *modoc* at Tahoe City in the same state. Schwarz had previously recorded *C. levigatus* as a host of *X. montana*, and Wirtner has found it living with its summer host, *F. subpolita*.

From the following table, which summarizes our present knowledge of the hosts of our five *Xenodusa*æ, it will be seen that both hosts are known of only two of the species:

1. *X. cava* Leconte.

Summer hosts: *Formica schaufussi* var. *incerta* (Wheeler); *F. exsectoides* (McCook); ?*F. sanguinea* subsp. *rubicunda* (Muckermann).

Winter hosts: *Camponotus herculeanus* subsp. *pennsylvanicus* (Schwarz, Blanchard, Pricer, Brues, Wheeler) and its var. *ferrugineus* (Fenyès); *C. herculeanus* subsp. *ligniperda* var. *noveboracensis* (Schwarz, Wickham, Muckermann, Wheeler); *C. castaneus* subsp. *americanus* (Reiff and Strickland).

2. **X. montana Casey.**

Summer host: Formica subpolita (Wirtner).

Winter hosts: Camponotus levigatus (Schwarz, Fenyès); *C. herculeanus* var. *modoc* (Fenyès).

3. **X. caseyi Wasmann.**

Summer host: Formica subpolita (Wirtner).

4. **X. sharpi Wasmann.**

Winter host: Camponotus auricomus (Wasmann).

5. **X. angusta Fall.**

Winter host: Camponotus fallax subsp. *discolor* var. *clarithorax* (Fenyès).

AN ANT-NEST COCCINELLID (BRACHYACANTHA QUADRIPUNCTATA MELS.).¹

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Early in May, 1910, while I was collecting on the rocky southern slope of Great Blue Hill near Boston, Mass., my curiosity was aroused by some snow-white insects, resembling gigantic Coccids, in several nests of *Lasius umbratus* var. *aphidicola*. From hasty examination I conclude that these insects, which were moving about slowly or resting among the root-Coccids and root-Aphids so abundant during the spring months in the *aphidicola* nests, must be predaceous Coccinellid larvæ. Unfortunately, the vial in which they were collected dropped from my pocket and was lost before I could examine them at my leisure.

May 6, 1911, on returning to the same locality, I succeeded in finding ten of the larvæ in two nests of the same ant. Each of these nests also contained a large number of root-Coccids. Larvæ, ants and Coccids were taken home and placed in an artificial nest. The larvæ, when first found, were covered with dense tufts of delicate white wax, but these broke off in transit through rubbing against particles of earth, so that the specimens were almost denuded when they were installed in the nest. New tufts of wax, however, at once began to be secreted, and by May 15 the larvæ had the appearance

¹ Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 43.